AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application. Please amend Claims 15, 17, 19, 23, 29, 35-36, 40, and 47 as follows:

1. (Previously Presented) A locomotive, comprising:

a plurality of direct current traction motors corresponding to a plurality of axles and a plurality of drive switches, each traction motor operating in a driven mode and a free-wheeling mode, wherein in the driven mode a power pulse from an energy storage device passes through the traction motor and the corresponding drive switch and in the free-wheeling mode the power pulse from the energy storage device passes through the traction motor and bypasses the corresponding drive switch;

a plurality of filters, each filter corresponding to one of the plurality of direct current traction motors, to absorb electrical voltage transients and smooth current ripples through the traction motors resulting from changes between the driven and free-wheeling modes; and

a controller operable to determine a respective power requirement for each traction motor during a selected time interval and the necessary amplitude and pulse width of a power pulse to produce the determined power requirement for each traction motor, wherein during the selected time interval the respective power requirements of at least two traction motors are different.

2. (Previously Presented) The locomotive of Claim 1 further comprising:

a plurality of free-wheeling bypass circuits, each bypass circuit bypassing a corresponding one of the plurality of drive switches; and

a switch drive operable to pulse sequentially power to each of the traction motors to produce the respective power requirement during the selected time interval, wherein, when the revolutions per minute (RPM) of each of the traction motors is below an intermediate

RPM threshold, the pulses provided to the direct current traction motors are temporally non-overlapping and, when the RPM of each of the traction motors is above the intermediate RPM threshold, the pulses provided to the direct current traction motors are temporally at least partially overlapping.

3. (Previously Presented) The locomotive of Claim 2, further comprising:

a plurality of chopper circuits corresponding to the plurality of direct current traction motors, each chopper circuit comprising the free-wheeling bypass circuit, the drive switch being in electrical communication with a respective direct current traction motor, and at least one of the filters, wherein a temporal spacing between adjacent pulses to each traction motor is maximized.

4. (Previously Presented) The locomotive of Claim 3, wherein, during a selected time interval, a first chopper circuit corresponding to a first traction motor is in the first mode and a second chopper circuit corresponding to a second traction motor is in the second mode and wherein over-current protection for each individually controlled traction motor is provided.

5. (Previously Presented) A locomotive, comprising:

a plurality of direct current traction motors in communication with a plurality of axles;

a prime energy source;

an energy conversion device, in communication with the prime energy source, to convert the energy output by the prime energy source into direct current electricity;

an energy storage device, in communication with the energy conversion device and the plurality of traction motors, to receive and store the direct current electricity;

a plurality of electrical storage subunits to receive, store, and supply the direct current electricity, wherein in a first mode the electrical storage subunits are connected electrically

in series and in a second mode the electrical storage subunits are connected electrically in parallel; and

at least one switch to switch the electrical storage subunits between the first and second modes.

6. (Previously Presented) The locomotive of Claim 5 further comprising:

a controller of the at least one switch, wherein, when a measured voltage output of the electrical storage subunits is lower than a selected threshold, the at least one switch switches to the first mode and, when the measured voltage output of the electrical storage subunits is greater than the selected threshold, the at least one switch switches to the second mode.

7. (Original) The locomotive of Claim 5 wherein simultaneously some of the electrical storage subunits are electrically connected in series and others of the electrical storage subunits are electrically connected in parallel.

8. (Previously Presented) A locomotive, comprising:

a plurality of direct current traction motors in communication with a plurality of axles;

a prime energy source;

an energy conversion device, in communication with the prime energy source, to convert the energy output by the prime energy source into direct current electricity;

an energy storage device, in communication with the energy conversion device and the plurality of traction motors, to receive and store the direct current electricity, wherein the energy storage device comprises a plurality of capacitors operable to store the stored energy; and

a pulse forming network to maintain the output power pulses of the energy storage device at least substantially constant in magnitude.

9. (Previously Presented) The locomotive of Claim 8 wherein at least most of the stored electricity is stored in the plurality of capacitors and wherein the pulse forming network includes a buck-boost chopper circuit.

10. (Previously Presented) The locomotive of claim 9 wherein the waveform representing the amplitude of the output of the energy storage device as a function of time is at least substantially linear.

11. (Previously Presented) A locomotive, comprising:

a plurality of traction motors in communication with a plurality of axles;

a prime energy source for providing power to the plurality of traction motors; and

a plurality of air brake systems operatively engaging a respective one of the plurality of axles, each air brake system comprising at least one movable braking surface element and corresponding air-brake cylinder and a fluid-activated brake release, wherein, when a moveable braking surface element is locked in position against a braking surface, fluid pressure is applied against the braking surface by the fluid-activated brake release to disengage the locked moveable braking surface from the braking surface.

12. (Previously Presented) The locomotive of Claim 11, further comprising:

an energy conversion device, in communication with the prime energy source, to convert the energy output by the prime energy source into direct current electricity;

an energy storage device, in communication with the energy conversion device and the plurality of traction motors, to receive and store the direct current electricity, wherein the moveable braking surface element is a perforated brake shoe and wherein the air brake systems each comprise a brake shoe housing including the perforated brake shoe and wherein, when the fluid-activated brake release is activated, the high pressure fluid is passed through

the brake shoe perforations and against the interface between the engaged brake shoe and the braking surface of the wheel to effect physical separation of the brake shoe and the wheel braking surface.

13. (Original) The locomotive of Claim 11 wherein each moveable braking surface element comprises a plurality of holes passing therethrough and the fluid-activated brake release forces fluid through the holes in the moveable braking surface element and against the braking surface to form a brake release force.

14. (Original) The locomotive of Claim 13 wherein the force required to unlock a locked braking surface element is the braking force and the release force is at least about 10% greater than the braking force.

15. (Currently Amended) A locomotive, comprising:

a plurality of direct current traction motors in communication with a plurality of axles;

a prime energy source;

an energy conversion device, in communication with the prime energy source, to convert the energy output by the prime energy source into direct current electricity;

an energy storage device, in communication with the energy conversion device and the plurality of traction motors, to receive and store the direct current electricity;

a controller operable to control an excitation current to the energy conversion device, wherein at least one of the following statements is true:

[[(I)]](i) when a first predetermined set point is exceeded by a first monitored parameter, the excitation current is increased and, when a second predetermined set point is exceeded by the first monitored parameter, the excitation current is decreased and wherein the first monitored parameter is revolutions per minute of a mechanical component of the prime energy source and

(ii) when the first predetermined set point is exceeded by a second monitored parameter, the excitation current is decreased and, when the second predetermined set point is exceeded by the second monitored parameter, the excitation current is increased and wherein the second monitored parameter is the output power of the energy conversion device.

16. (Original) The locomotive of Claim 15 wherein the first and second predetermined set points are selected to produce at least a desired degree of fuel efficiency for the prime energy source.

17. (Currently Amended) The locomotive of Claim 15 wherein [[(I)]]<u>(i)</u> is true.

18. (Original) The locomotive of Claim 15 wherein (ii) is truc.

19. (Currently Amended) A method for providing electrical energy to an energy storage device in a locomotive, comprising:

(a) providing a locomotive comprising:

(i) a plurality of direct current traction motors in communication with a plurality of axles;

(ii) a prime energy source;

(iii) an energy conversion device, in communication with the prime energy source, to convert the energy output by the prime energy source into direct current electricity; and

(iv) an energy storage device, in communication with the energy conversion device and the plurality of traction motors, to receive and store the direct current electricity; and

(b) controlling an excitation current to the energy conversion device by performing at least one of the following steps:

[[(I)]](i) when a first predetermined set point is exceeded by a first monitored parameter, the excitation current is increased and, when a second predetermined set point is exceeded by the first monitored parameter, the excitation current is decreased and wherein the first monitored parameter is revolutions per minute of a mechanical component of the prime energy source and

(ii) when the first predetermined set point is exceeded by a second monitored parameter, the excitation current is decreased and, when the second predetermined set point is exceeded by the second monitored parameter, the excitation current is increased and wherein the second monitored parameter is the output power of the energy conversion device.

20. (Original) The method of Claim 19 wherein the first and second predetermined set points are selected to produce at least a desired degree of fuel efficiency for the prime energy source.

21. (Original) The locomotive of Claim 19 wherein step (i) is performed.

22. (Original) The locomotive of Claim 19 wherein step (ii) is performed.

23. (Currently Amended) A locomotive, comprising:

a plurality of direct current traction motors in communication with a plurality of axles;

a prime energy source;

an energy conversion device, in communication with the prime energy source, to convert the energy output by the prime energy source into direct current electricity;

an energy storage device, in communication with the energy conversion device and the plurality of traction motors, to receive and store the direct current electricity;

a controller operable to [[(I)]](i) monitor an operational parameter of each of the plurality of axles and/or traction motors, wherein the monitored operational parameter

includes (a) an electrical current and/or voltage output by the energy storage devicc and (b) a state of charge and/or voltage of the energy storage device, and (ii) in response to the monitored operational parameter, control operation of the prime energy source.

24. (Previously Presented) The locomotive of Claim 23 wherein the controller is operable to:

when the prime energy source is activated,

deactivate the prime energy source when the energy storage device voltage and/or state of charge is above a second set point; and

when the prime energy source is deactivated,

activate the prime energy source when the energy storage device voltage and/or state of charge is below a first set point.

25. (Previously Presented) The locomotive of Claim 24 wherein the controller is operable to control each of the plurality of traction motors independently of the other traction motors, wherein the controller is operable to decrease power supplied to a first traction motor engaging a first axle without decreasing the power supplied to other traction motors when the revolutions per minute exceed a selected threshold, and wherein the controller is operable, when the prime energy source is activated, to generate a warning when the energy storage device voltage and/or state of charge is below a first set point.

26. (Previously Presented) The locomotive of Claim 23 wherein the controller is operable to:

determine, based on the measured current and/or voltage output by the energy storage device, a state of charge of the energy storage device; and

when the state of charge is below a selected set point, indicate a warning to an operator.

27. (Previously Presented) The locomotive of Claim 25 further comprising:

an air brake assembly located on each of the plurality of axles, the air brake assembly comprising one or more brake shoes, an air cylinder, and an fluid-activated brake release, wherein, when a first air brake assembly is locked in engagement with a first braking surface on a first axle but a second air brake assembly is not locked into engagement with a second braking surface on a second axle, the controller is operable to activate a first fluid-activated brake release on the first axle without activating a second fluid-activated brake release on the second axle.

28. (Previously Presented) The locomotive of Claim 27, wherein a brake assembly is deemed to be locked when the locomotive is in motion, the air brake assembly is deactivated, and the revolutions per minute on the axle engaging the air brake assembly are at least substantially zero.

29. (Currently Amended) A method for controlling the operation of a locomotive, comprising:

(a) providing a locomotive, the locomotive comprising:

[[(I)]](i) a plurality of direct current traction motors in communication with a plurality of axles;

(ii) a prime energy source;

(iii) an energy conversion device, in communication with the prime energy source, to convert the energy output by the prime energy source into direct current electricity; and

(iv) an energy storage device, in communication with the energy conversion device and the plurality of traction motors, to receive and store the direct current electricity;

(b) monitoring an operational parameter of each of the plurality of axles and/or traction motors, wherein the monitored operational parameter includes (a) an electrical

current and/or volts output by the energy storage device and (b) a state of charge and/or voltage of the energy storage device and

[[©]](c) in response to the monitored operational parameter, controlling activation and deactivation of the prime energy source to control provision of direct current electricity to the energy storage device.

30. (Previously Presented) The method of Claim 29 wherein the controlling step (c) comprises the substeps of:

when the prime energy source is activated,

generating a warning when the energy storage device voltage and/or state of charge is below a first set point; and

deactivating the prime energy source when the energy storage device voltage and/or state of charge is above a second set point; and

when the prime energy source is deactivated,

activating the generator when the energy storage device voltage and/or state of charge is below the first set point.

31. (Previously Presented) The method of Claim 29 further comprising:

controlling each of the plurality of traction motors independently of the other traction motors; and

decreasing power supplied to a first traction motor engaging a first axle without decreasing the power supplied to other traction motors when the revolutions per minute of the first axle exceed a selected threshold.

32. (Previously Presented) The method of Claim 29 wherein the controlling step comprises the substeps of:

determining, based on the measured current and/or voltage output by the energy storage device, a state of charge of the energy storage device; and

when the state of charge is below a selected set point, generating a warning to an operator.

33. (Previously Presented) The method of Claim 29 wherein the locomotive comprises an air brake assembly located on each of the plurality of axles, the air brake assembly comprising one or more brake pads, an air cylinder, and an air-activated brake release and further comprising:

when a first air brake assembly is locked in engagement with a first braking surface on a first axle but a second air brake assembly is not locked into engagement with a second braking surface on a second axle, activating a first fluid-activated brake release on the first axle without activating a second fluid-activated brake release on the second axle.

34. (Original) The locomotive of Claim 33 wherein a brake assembly is deemed to be locked when the locomotive is in motion, the air brake assembly is deactivated, and the revolutions per minute on the axle engaging the air brake assembly are at least substantially zero.

35. (Currently Amended) A locomotive, comprising:

a plurality of direct current traction motors in communication with a plurality of axles;

a prime energy source;

an energy conversion device, in communication with the prime energy source, to convert the energy output by the prime energy source into direct current electricity;

an energy storage device, in communication with the energy conversion device and the plurality of traction motors, to receive and store the direct current electricity;

a user interface operable to receive a command from an operator to control a locomotive speed at a specified velocity; and

a controller operable to control the velocity of the locomotive at or near the specified velocity by performing at least one of the following steps:

[[(I)]](i) maintaining a substantially constant power across each of the plurality of traction motors, the power being related to the specified velocity; and

(ii) maintaining the revolutions per minute of each of the plurality of axles at a rate related to the specified velocity.

36. (Currently Amended) The locomotive of Claim 35 wherein step [[(I)]](i) is performed.

37. (Original) The locomotive of Claim 35 wherein step (ii) is performed.

38. (Original) The locomotive of Claim 35 wherein corresponding power applied across at least two of the traction motors are different.

39. (Original) The locomotive of Claim 35 wherein corresponding revolutions per minute of at least two of the axles are different.

40. (Currently Amended) A method for operating a locomotive, comprising:

(a) providing a locomotive, the locomotive comprising:

[[(I)]](i) a plurality of direct current traction motors in communication with a plurality of axles;

(ii) a prime energy source;

(iii) an energy conversion device, in communication with the prime energy source, to convert the energy output by the prime energy source into direct current electricity;

(iv) an energy storage device, in communication with the energy conversion device and the plurality of traction motors, to receive and store the direct current electricity; and

(v) a user interface operable to receive a command from an operator to control a locomotive speed at a specified velocity; and

(b) controlling the velocity of the locomotive at or near the specified velocity by performing at least one of the following steps:

[[(I)]](i) maintaining a substantially constant power across each of the plurality of traction motors, the power being related to the specified velocity; and

(ii) maintaining the revolutions per minute of each of the plurality of axles at a rate related to the specified velocity.

41. (Currently Amended) The method of Claim 40 wherein step [[(I)]](i) is performed.

42. (Original) The method of Claim 40 wherein step (ii) is performed.

43. (Original) The method of claim 40 wherein corresponding power applied across at least two of the traction motors are different.

44. (Original) The method of Claim 40 wherein corresponding revolutions per minute of at least two of the axles are different.

45. (Previously Presented) A power control system for a locomotive, comprising:
a plurality of direct current traction motors in communication with a plurality of axles;
a prime energy source;

an energy conversion device, in communication with the prime energy source, to convert the energy output by the prime energy source into direct current electricity;

an energy storage device, in communication with the energy conversion device and the plurality of traction motors, to receive, store, and supply the direct current electricity;

a user interface operable to receive a command from an operator to control a locomotive speed at a specified velocity;

a controller operable to determine an electrical current passing through each of a plurality of direct current traction motors; and

a graphical user interface operable to display a current power being delivered by the energy storage device, a voltage of the energy storage device, an electrical current of the energy storage device, and a state of charge of the energy storage device to permit the operator to monitor a state of the energy storage device.

46. (Previously Presented) The power control system of claim 45, wherein the controller is operable to:

when the prime energy source is activated,

generate a warning when the energy storage device voltage and/or state of charge is below a first set point; and

deactivate the prime energy source when the energy storage device voltage and/or state of charge is above a second set point; and

when the prime energy source is deactivated,

activate the generator when the energy storage device voltage and/or state of charge is below the first set point.

47. (Currently Amended) A power control method for a locomotive, comprising:

providing a locomotive comprising:

[[(I)]](i) a plurality of direct current traction motors in communication with a plurality of axles;

(ii) a prime energy source;

(iii) an energy conversion device, in communication with the prime energy source, to convert the energy output by the prime energy source into direct current electricity;

(iv) an energy storage device, in communication with the energy conversion device and the plurality of traction motors, to receive and store the direct current electricity;

(v) a user interface operable to receive a command from an operator to control a locomotive speed at a specified velocity;

displaying a current power being delivered by the energy storage device, a voltage of the energy storage device, an electrical current from the energy storage device, and a state of charge of the energy storage device; and

receive commands from the operator in response to the displayed information.

48. (Previously Presented) The power control method of claim 47, further comprising:

when the prime energy source is activated,

generating a warning when the energy storage device voltage and/or state of charge is below a first set point; and

deactivating the prime energy source when the energy storage device voltage and/or state of charge is above a second set point; and

when the prime energy source is deactivated,

activating the generator when the energy storage device voltage and/or state of charge is below the first set point;

determining, based on the measured current and/or voltage output by the energy storage device, a state of charge of the energy storage device; and

when the state of charge is below a selected set point, generating a warning to an operator.